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Direct Visualization of Shear Induced Structures in Wormlike Micellar Solutions by Microfluidics and Advanced Microscopy

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Abstract : In the last decades, wormlike micellar solutions have been extensively used to tune the rheological behavior of home care and personal care products. This and other successful applications underlie the growing attention that both basic and applied research are devoting to these systems, and to their unique rheological and flow properties. One of the key research topics is the occurrence of flow instabilities at high shear rates (such as shear banding), with the possibility of appearance of flow induced structures. In this scenario, microfluidics is a powerful tool to get a deeper insight into the flow behavior of a wormlike micellar solution, as the high confinement of a microfluidic device facilitates the onset of the flow instabilities; furthermore, thanks to its small dimensions, it can be coupled with optical microscopy, allowing a direct visualization of flow structuring phenomena. Here, the flow of a widely used wormlike micellar solution through a glass capillary has been studied, by coupling the microfluidic device with μPIV techniques. The direct visualization of flow-induced structures and the flow visualization analysis highlight a relationship between solution structuring and the onset of discontinuities in the velocity profile.

Keywords : flow instabilities, flow-induced structures, μPIV, wormlike micelles
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